Great Lakes
BEACH, TRIBUTARY, & NEARSHORE BACTERIAL WATER QUALITY

Hydrologic and Hydrodynamic Data and Model Assimilation Project

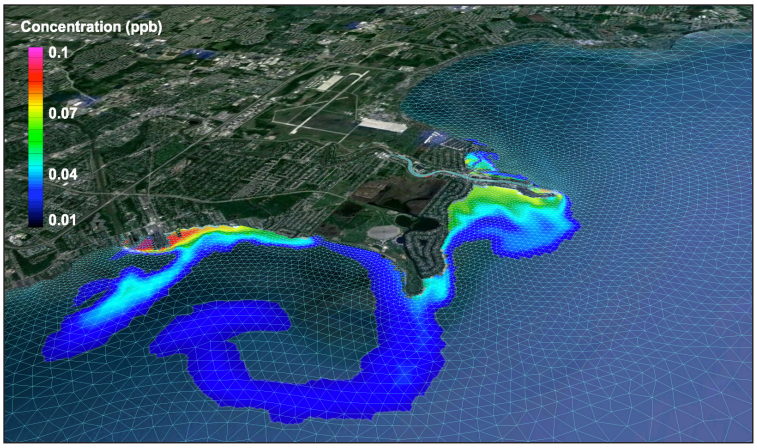
Beach closures are commonly made based on day-old monitoring results assumed to be representative of the current days' bacterial water quality conditions. This assumption is recognized as inadequate by research and regulatory communities alike. The need to advance predictive ability and move beyond the current closure protocol is essential to protecting human health. In order to address this need, scientists from CILER (Cooperative Institute for Limnology and Ecosystems Research) and NOAA's Great Lakes Environmental Research Laboratory (GLERL) are developing a process-model-based bacterial water quality forecasting system for use at targeted beaches throughout the Great Lakes. Funding is provided by the Great Lakes Restoration Initiative (GLRI). This system is intended for use by local authorities to improve their capability to forecast water quality conditions which may lead to a violation of fecal indicator bacteria (FIB) based water quality standards and present a risk to human health.

Project Information

This project seeks to not only better understand beach water quality, but the complete nearshore environment. We believe that only by investigating and understanding a suite of possible factors that may contribute to nearshore water quality will we be able to accurately predict it. Our long-term goal is to develop a bacterial water quality forecasting system intended to improve the capability of beach managers and local authorities to predict when water quality conditions are such that they are likely to violate fecal indicator bacteria (FIB) based water quality standards, thus reducing the practice of using day-old data to regulate beaches.

There are three components to the development of a FIB forecasting system:

1. pollutant fate and transport modeling
2. hydrodynamic modeling
3. fecal indicator bacteria (FIB) monitoring



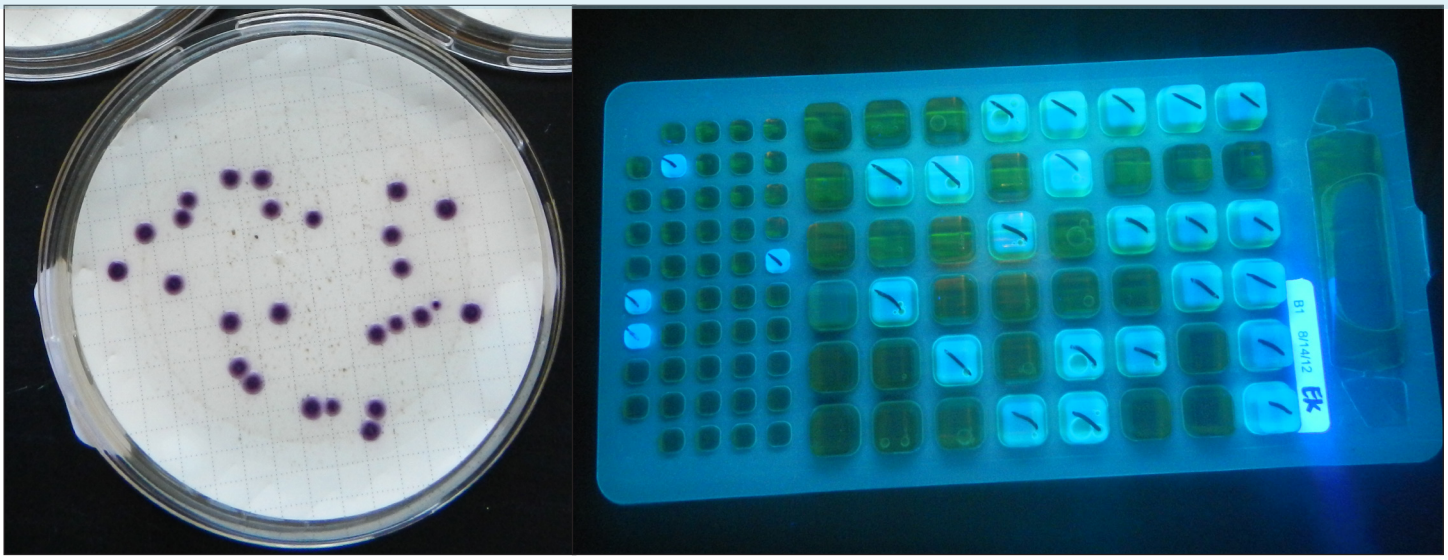
Output from the GLERL-developed Huron to Erie Connecting Waterways Forecasting System with Google overlay. The model predicts real-time water levels and currents to simulate where bacteria and other possible contaminants will travel in the lake.

We use a process-based pollutant fate and transport model to simulate the process of bacteria accumulating on the ground and being washed into the river/steam. when it rains. We do this using amount of rainfall, estimating the number of wildlife and leaking septic systems in the watershed, and accounting for the lifespan of the bacteria in different conditions. This model tells us how much bacteria is entering the river or lake on any given day. We then provide this pollutant load from the river to a hydrodynamic model which simulates where this bacteria moves in the lake using currents, temperatures, and water level fluctuations. Linking the two models together to use as a forecasting tool assumes that the watershed makes a significant contribution to the nearshore water quality.

What are fecal indicator bacteria (FIB) and where do they come from?

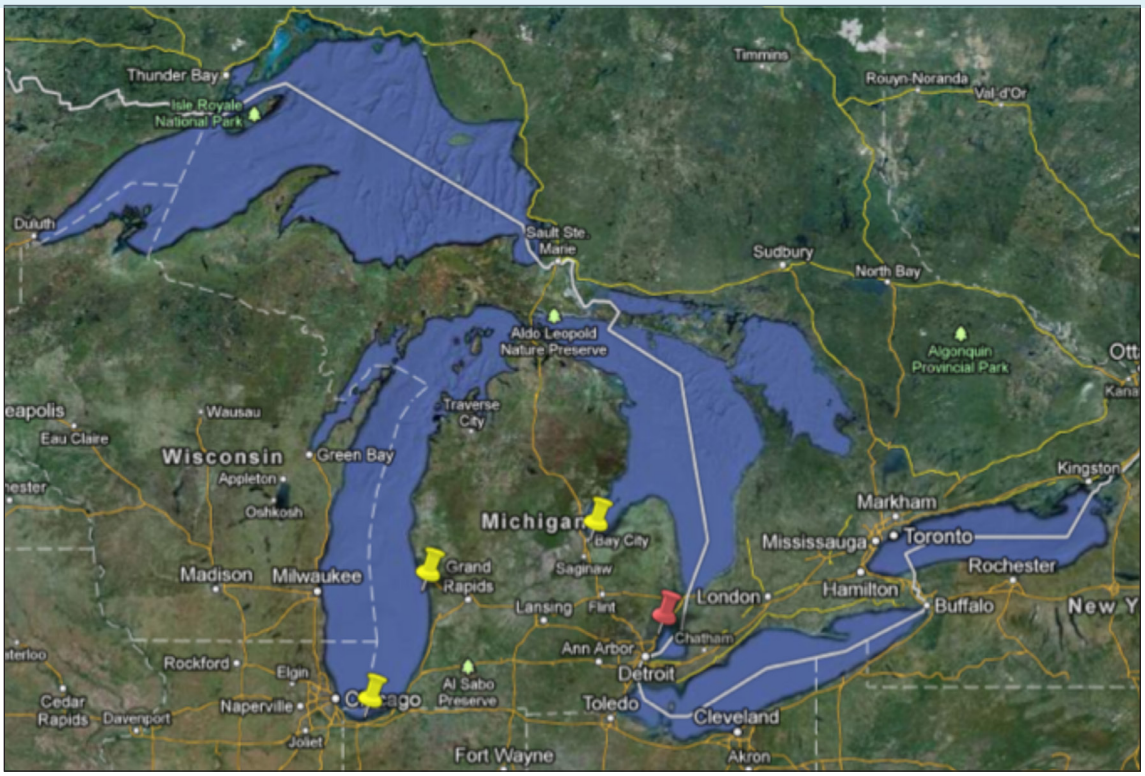
Fecal indicator bacteria (FIB) are bacteria such as *E. coli* and Entercoccus, which live in the gut of warm blooded animals and are introduced into the environment through fecal matter. Most FIB are harmless to humans. The presence of FIB indicates that pathogens also found in fecal matter, which are harmful to humans, may also be present.

Analysis Methods



To make sure that our forecasting system is working well, we use observed monitoring data to calibrate, confirm, and verify its results. We quantify the concentration of *E. coli* for this project using both membrane filtration and IDEXX Colilert methods. Membrane filtration allows for the quantification of *E. coli* in a water sample by growing it on selective media, which encourages *E. coli* growth yet prevents the growth of other bacteria (left). The IDEXX Colilert method detects *E. coli* when the organism metabolizes a nutrient indicator (MUG) using a unique enzyme (β-galactosidase) causing it to fluoresce (right).

Geographic Extent



Locations with yellow pins indicate places where a hydrodynamic model is in place. Locations with red pins are places where a hydrodynamic model is in place and nearshore bacterial water quality monitoring has begun in order to verify both pollutant fate and transport and hydrodynamic models. Monitoring efforts are expected to expand to other locations in the next 1-3 years.

Please visit our project website

for more information about the project, to view model simulations, and to access monitoring results.

http://www.glerl.noaa.gov/res/Centers/HumanHealth/nearshoreFIB/index.html

GLERL Great Lakes Environmental Research Laboratory

Great Lakes RESTORATION

CILER